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Research Paper

Nutritional and Physico-chemical Qualities of Popular Retail Cuts of Large White Yorkshire pig

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ABSTRACT

Four popular retail cuts of Large White Yorkshire pigs (16 nos.) weighing 80 to 90 Kg body weight were analysed for the proximate composition, fatty acids, cholesterol, energy, minerals and other physico-chemical composition. The mean content (%) of moisture (58.62 ± 0.168 to 74.77 ± 0.165), protein (15.73 ± 0.109 to 20.85 ± 0.131), lipids (3.45 ± 0.106 to 22.94 ± 0.132), ash (0.83 ± 0.017 to 1.01 ±0.015), monounsaturated fatty acids (1.38 ± 0.019 to 9.25 ± 0.034), poly unsaturated fatty acids (0.52 ± 0.021 to 3.06± 0.025), saturated fatty acids (1.18 ± 0.024 to7.34 ± 0.032) of raw cuts were recorded. Further, cholesterol (mg/100g) (65.99 ± 0.133to 79.83 ± 0.106), energy content (kcal/100g) (130.34 ± 1.03 to 270.36 ± 1.24) and mineral compositions (mg/100g) viz., iron (0.45 ± 0.015 to 0.95 ± 0.015), calcium (6.45 ± 0.152 to 20.43 ± 0.160) sodium (45.58 ± 0.209 to 78.71 ± 0.135) and potassium (238.31 ± 0.876 to 398.51 ± 0.989) were also carried out. Physico-chemical parameters like fiber diameter (μm) (45.24 ± 0.151 to 51.01 ± 0.156), sarcomere length (μm) (2.64 ± 0.015 to 2.79 ± 0.012), hydroxyproline (mg/100g) (1.26 ± 0.014 to 1.41 ± 0.013), pH (5.63 ± 0.012 to5.77 ± 0.013) and water holding capacity (%) (43.03 ± 0.091 to 49.68 ± 0.090) of raw meat cuts werealso recorded. Significant difference ($p<0.05$) has been observed for almost all the proximate composition and fatty acids and energy content,mineral and other physico-chemical compositions parameters of meat, location wise. On cooking, all the parameters increased except moisture, sodium,potassium, fiber diameter, sarcomere length and water holding capacity, which decreased significantly ($p<0.05$) as compared to their raw counter parts.

Keywords : *Proximate compositions, Fatty acids, Mineral contents, Physico-chemical qualities, Porkretail cuts*

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INTRODUCTION

Pork is an excellent source of high quality protein, B-vitamins and trace elements and known to play a key role in providing a good and cheap source of essential nutrients to man. Pork is the most widely eaten meat in the world and recent evidence shows that diets high in pork, with and without energy restriction, may have favorable effects on body composition (Karen *et al*. 2014). However the pork contains considerable amounts of saturated fatty acids and cholesterol, excess consumption leads to cardio-vascular diseases. Consumers rightly expect that the products they purchase are of high quality and this is especially true for meat and meat products. Choosing a particular meat cut of a specific fatness level can make a significant contribution to decrease energy in take, from a total diet perspective. Knowledge of the carcass composition is therefore necessary to provide the preferred cut as per consumer's requirement. Accurate nutrient composition data are essential in communicating nutrition information to consumers.

Proximate composition, fatty acids, cholesterol energy and mineral contents have been studied in goat (Banskaliva *et al*. 2000), buffalo (Biswas *et al.* 2010) and pig (Khan *et al*. 2009; Patterson *et al*. 2009; Halter 2012). On the other hand studies on physico-chemical properties like fiber diameter, sarcomere length, hydroxiproline content, water holding capacity, pH etc. have also been done in goat and beef (Hildrum *et al.* 2009) and in pork (Wheeler *et al*. 2000; Lawrie 2006). However scientific data in this respect in Indian condition is inadequate. In view of the above, an attempt was made to determine the proximate composition, fatty acids, energy contents and physico-chemical qualities of 4 retail cuts of Large White Yorkshire pig.

MATERIALS AND METHODS

Sixteen Large White Yorkshire pigs of either sex (80 to 90 kg body weight) reared scientifically under same management condition at Haringhata farm of animal resources development department, Govt. of West Bengal were utilized for the study. Pigs were hygienically slaughtered at meat plant of Haringhata farm under West Bengal Livestock Development Corporation limited following resting, fasting, stunning, bleeding, scalding, singeing, dehairing and washing. After dressing, chilling was done overnight at 4±1°C. Pork samples were collected from each of shoulder blade (steaks), loin, center rib (chops), spare ribs and tenderloin, taken from both sides of

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carcasses for analysis of raw cuts. Meat samples from the four cuts, intended to be used for the cooked analysis, were vacuum packed and frozen at -20°C until the cooking process commenced. The four cuts were defrosted for 24 hours and cooked according to standardized moist heat cooking method at 163°C to an internal temperature of 73°C measured in the geometrical centre of the cut (American Meat Science Association 1995).

The moisture, protein, ether extracts and total ash contents of meat samples were determined by the method of AOAC (1995). The analysis of MUFA, PUFA and saturated fatty acids content was performed in accordance with the procedure described by O'Fallon *et al*.(2007). Total cholesterol was determined by using the method as described by Rajkumar *et al*. (2004). Gross energy value was estimated as per standard method. Iron, calcium, sodium and potassium assays were measured by atomic absorption spectrophotometry (Perkin Elmer 1982). Fiber diameter was measured as per the method outlined by Jeremiah and Martin (1982). The sarcomere length was measured adapting the procedures of Warner *et al.* (1997). Total collagen (based on hydroxyproline content) was determined as per Wattanachant *et al.* (2004). Water holding capacity of meat sample was estimated by following the method of Nakamura and Kotah (1985). The pH of the minced meat sample was determined by the method of Trout *et al.* (1992).

Statistical analysis of data were carried out by one way analysis of variance as per method described by Snedecor and Cochran (1989) and to compare the means at 5 % level of significance, Tukey's HSD test for equality of variances was employed by using SPSS 16 software package. To compare the effect of cooking on different parameters of pork, independent sample t-test has been followed by SPSS-16 software package, assuming equal variances.

RESULTS AND DISCUSSION

The proximate compositions of different raw and cooked meat from different popular retail fresh pork cuts depicted in Table 1, indicates that tenderloin contains highest moisture and protein but lowest fat whereas spare ribs contains lowest moisture, protein but highest fat among all cuts. Significant difference ($p<0.05$) in all the proximate composition of meat, location wise was observed except total ash content which did not differ significantly ($p>0.5$) in between shoulder blade(steaks) and tenderloin. On cooking, moisture (%) decreased whereas, protein, fat and ash contents increased significantly ($p<0.05$) in all cuts.These findings were in close agreement with that of Khan *et al*. (2009) and Patterson *et al*. (2009). According to Lawrie (1998), it is feasible that significant differences may exist between specific muscle locations in the carcass or that breed and age has an effect. Biswas *et al.* (2010) reported that the loin and breast muscles were found to be the best in respect of protein content of buffalo meat which is in contrast with the present study, which may be due to presence of back fat in the loin cuts of pork. On cooking, the protein, lipid and ash content (%) increased significantly ($p<0.05$) as a result of reduction of relative moisture content. Pellet and

Table 1: Proximate composition, fatty acid, cholesterol, energy and mineral content of raw and cooked meat from different pork cuts

Parameters	Shoulder Blade (steaks)		Loin center rib (chops)		Spare Rib		Tenderloin	
	Raw	Cooked	Raw	Cooked	Raw	Cooked	Raw	Cooked
Moisture (%)	$69.45^{ax} \pm 0.11$	$63.21^{ay} \pm 0.068$	$68.15^{bx} \pm 0.149$	$66.00^{by} \pm 0.198$	$58.62^{cx} \pm 0.168$	$48.19^{cy} \pm 0.151$	$74.77^{dx} \pm 0.165$	$68.88^{dy} \pm 0.187$
Protein (%)	$17.52^{ax} \pm 0.131$	$23.67^{ay} \pm 0.158$	$20.24^{bx} \pm 0.112$	$26.18^{by} \pm 0.123$	$15.73^{cx} \pm 0.109$	$20.98^{cy} \pm 0.222$	$20.85^{dx} \pm 0.131$	$26.12^{by} \pm 0.108$
Ether Extract (%)	$11.75^{ax} \pm 0.158$	$17.26^{ay} \pm 0.101$	$10.61^{bx} \pm 0.107$	$6.01^{by} \pm 0.111$	$22.94^{cx} \pm 0.132$	$30.51^{cy} \pm 0.122$	$3.45^{dx} \pm 0.106$	$3.94^{dy} \pm 0.136$
Total Ash (%)	$0.98^{ax} \pm 0.015$	$1.03^{ay} \pm 0.015$	$1.06^{bx} \pm 0.015$	$1.10^{bx} \pm .016$	$0.83^{cx} \pm 0.017$	$0.86^{cx} \pm 0.015$	$1.01^{abx} \pm 0.015$	$1.20^{dy} \pm .015$
MUFA (%)	$5.11^{ax} \pm 0.024$	$5.38^{ay} \pm 0.024$	$4.42^{bx} \pm 0.026$	$4.75^{by} \pm 0.026$	$9.25^{cx} \pm 0.034$	$9.88^{cy} \pm 0.034$	$1.38^{dx} \pm 0.019$	$1.57^{dy} \pm 0.019$
PUFA (%)	$1.80^{ax} \pm 0.023$	$1.86^{ax} \pm 0.023$	$1.59^{bx} \pm 0.025$	$1.64^{bx} \pm 0.025$	$3.06^{cx} \pm 0.025$	$3.32^{cy} \pm 0.023$	$0.52^{dx} \pm 0.021$	$0.56^{dx} \pm 0.023$
SFA (%)	$4.03^{ax} \pm 0.028$	$6.08^{ay} \pm 0.026$	$3.77^{bx} \pm 0.029$	$4.41^{by} \pm 0.025$	$7.34^{cx} \pm 0.032$	$8.33^{cy} \pm 0.028$	$1.18^{dx} \pm 0.024$	$1.32^{dy} \pm 0.024$
Cholesterol (mg/100g)	$61.18^{ax} \pm 0.150$	$84.78^{ay} \pm 0.168$	$57.95^{bx} \pm 0.156$	$65.99^{by} \pm 0.133$	$79.83^{cx} \pm 0.106$	$91.46^{cy} \pm 0.107$	$61.01^{dx} \pm 0.148$	$70.89^{dy} \pm 0.130$
Energy (Kcal/100g)	$175.68^{ax} \pm 1.29$	$236.29^{ay} \pm 1.72$	$179.41^{ax} \pm 1.33$	$221.36^{by} \pm 1.98$	$270.36^{bx} \pm 1.24$	$351.81^{cy} \pm 1.907$	$130.34^{cx} \pm 1.03$	$144.65^{dy} \pm 1.01$
Fe (mg/100g)	$0.89^{ax} \pm 0.012$	$1.42^{ay} \pm 0.020$	$0.45^{bx} \pm 0.015$	$0.52^{by} \pm 0.015$	$0.78^{cx} \pm 0.017$	$0.86^{cy} \pm 0.016$	$0.95^{dx} \pm 0.015$	$1.44^{ay} \pm 0.020$
Ca (mg/100g)	$12.56^{ax} \pm 0.161$	$18.50^{ay} \pm 0.159$	$20.43^{bx} \pm 0.160$	$23.93^{by} \pm 0.241$	$12.46^{ax} \pm 0.161$	$16.40^{cy} \pm 0.158$	$6.45^{cx} \pm 0.152$	$8.27^{dy} \pm 0.153$
Na(mg/100g)	$57.64^{ax} \pm 0.12$	$60.35^{ay} \pm 0.125$	$52.15^{bx} \pm 0.125$	$54.95^{by} \pm 0.117$	$78.71^{cx} \pm 0.135$	$87.31^{cy} \pm 0.134$	$45.58^{dx} \pm 0.209$	$51.04^{by} \pm 2.619$
K (mg/100g)	$315.25^{ax} \pm 0.83$	$302.10^{ay} \pm 0.837$	$337.48^{bx} \pm 0.802$	$328.58^{by} \pm 0.894$	$238.31^{cx} \pm 0.876$	$251.28^{cy} \pm 0.88$	$398.51^{dx} \pm 0.989$	$419.73^{dy} \pm 1.03$

Means with common superscripts in a row did not differ significantly ($p<0.05$); n=16

Young (1990) also reported that the protein and fat content (%) of pork chops increased due to cooking.

The fatty acids, cholesterol and energy compositions depicted in Table 1 indicatesspare ribs has the highest and tenderloin has the lowest mean levels for MUFA, PUFA, SFA and energy content. However, cholesterol content was highest in spare ribs and lowest in loin, centre ribs. Significant difference ($p<0.05$) in all most all the parameters of meat, location wise has been observed. Suchresults show that higher pig meatiness is accompanied by lower content of saturated fatty acids and cholesterol which is in accordance to the studies made by Jacyno *etal*. (2006). On cooking, MUFA, SFA, cholesterol and energy content increased significantly locationwise though PUFA content increased significantlyin case of spare rib.This might be due to proportionate increase in total fat due to moisture loss while cooking. Bragagonolo and Amya (2003) also reported that total lipids, cholesterol and fatty acids content of beef increased due to cooking. Cooking may lead to alteration of fatty acid, especially PUFA (Cortinus *et al.* 2004).

The mineral compositions indicates significant difference ($p<0.05$) among all the parameters of meat, location wise with few exception. Halter (2012) also reportedvariation in the contents ofFe, Ca, Na and K indifferent raw pork cuts. On cooking, the potassium content of shoulder, blade (steaks) and loin, center rib (chops) decreased whereas it increased ($p<0.05$) in spare ribs and tenderloin. Patterson *et al.* (2009) also observed that iron, calcium, sodium and potassium contents increased in cooked meat as compared to raw meat in case of some pork cuts whereas it also showed decreasing trend in some other pork cuts.

In case of raw cuts, shoulder and bladehas the highest mean levels and tenderloin has the lowest mean levels for fiber diameter, sarcomere length and hydroxiproline(Table 2). However loin and center rib had the highest mean level and tenderloin had the lowest mean level for water holding capacity and shoulder, blade had the highest mean level and spare ribs had the lowest mean level for pH. The trend was almost same in case of cooked meat cuts also with few exceptions. Significant differences ($p<0.05$) among all cuts except in between loin, center rib and spare ribs were also noticed. On cooking, fiber diameter, sarcomere length and WHC decreased significantly in all meat cuts whereas pH and hydroxiproline content increased.

Table 2: Physico-chemical quality parameters of raw and cooked meat from different pork cuts

Quality	Shoulder Blade (steaks)		Loin center rib (chops)		Spare Rib		Tenderloin	
paramters	Raw	Cooked	Raw	Cooked	Raw	Cooked	Raw	Cooked
Fiber diameter (μm)	$51.01^{ax} \pm 0.156$	$46.06^{ay} \pm 0.151$	$47.66^{bx} \pm 0.119$	$42.61^{by} \pm 0.119$	$47.35^{b} \pm 0.133$	$42.17^{by} \pm 0.151$	$45.24^{cx} \pm 0.151$	$39.58^{cy} \pm 0.119$
Sarcomere Length (μm)	$2.79^{ax} \pm 0.012$	$2.41^{ay} \pm 0.015$	$2.67^{bx} \pm 0.015$	$2.31^{by} \pm 0.014$	$2.65^{bx} \pm 0.014$	$2.29^{by} \pm 0.011$	$2.64^{bx} \pm 0.015$	$2.26^{by} \pm 0.015$
Hydroxyproline content (mg/g)	$1.41^{ax} \pm 0.013$	$1.81^{ay} \pm 0.013$	$1.30^{bxc} \pm 0.014$	$1.68^{by} \pm 0.015$	$1.32^{bx} \pm 0.014$	$1.69^{by} \pm 0.016$	$1.26^{cx} \pm 0.014$	$1.46^{cy} \pm 0.015$
pH	$5.68^{ax} \pm 0.012$	$5.73^{ay} \pm 0.012$	$5.77^{bx} \pm 0.013$	$5.72^{ay} \pm 0.012$	$5.63^{cx} \pm 0.012$	$5.59^{by} \pm 0.014$	$5.66^{cx} \pm 0.012$	$5.60^{by} \pm 0.012$
Water holding capacity %	$49.05^{ax} \pm 0.119$	$44.34^{ay} \pm 0.103$	$49.68^{bx} \pm 0.090$	$43.21^{by} \pm 0.085$	$48.84^{ax} \pm 0.075$	$43.18^{by} \pm 0.094$	$43.03^{cx} \pm .091$	$44.53^{ay} \pm 0.101$

Means with common superscripts in a row did not differ significantly ($p<0.05$); n=16

The differences in fiber diameters and sarcomere length in different meat muscles have also been reported Karlsson *et al.*(1999).Variation in sarcomere length among major pork muscles was studied by Wheeler *et al.* (2000)who reported that *Longissimus* sarcomere length was not different from either *semimembranosus* or *biceps femoris* which is in accordance with present study. Muscular variation in hydrxiproline content as observed in the present study is supported by Lawrie (2006) who reported that the same varied from 426 μg to 2470 μg in pork.Variations in pH have also been shown between muscles as well as within particular muscles by Hildrum *et al.*(2009).Musclewise difference in WHC Water holding capacity as observed in the present study is supported by Stanicic *et al.* (2012). Reduction of fiber diameter and sarcomere length due to cooking as observed in the present study is in accordance with Wheeler *et al*. (2000).

CONCLUSION

From the observations in this study, it is concluded that significant differences exists in proximate composition, fatty acids content, energy content, mineral and other physico-chemical parameters among different pork cuts. Further, cooking had significant impact on nutritional and physico-chemical qualities of popular retail cuts of large white Yorkshire pigs. Cooking increased all the parameters except moisture, sodium, potassium, fiber diameter, sarcomere length and water holding capacity, which decreased significantly ($p<0.05$) as compared to their raw counter parts. Highest protein (%) was found in tenderloin and loin parts, on both raw and cooked basis though tenderloin part showed lowest fat (%). Moreover, tenderloin cuts also contained highest iron and potassiumand lowest fiber diameter and hydroxiproline content.

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